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ABSTRACT

A framework for curriculum design and a set of guidelines for curriculum development in gifted education are presented. The major dimensions guiding curriculum development for gifted students are: content, process, product, and learning environment. Curriculum content should be developed in such a way that it becomes more abstract, complex, varied, organized in larger chunks, economical with regard to details, comprehensive, and relevant for the future. Processes should include questioning strategies, open-ended activities, discovery learning, reasoning, student freedom of choice, active interaction among students, contact with mentors, fast pacing, and a constant varying of methods. Products should address real problems, communicate to real audiences, transform information, and be evaluated from several points of view. The learning environment should be student-centered, designed to foster student independence, open to new ideas, accepting, complex, and highly mobile. A series of teaching activities is described illustrating implementation of these educational principles in the areas of economics, historical research, and robotics. Includes five references. (JDD)

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CURRICULA AND TEACHING STRATEGIES FOR GIFTED STUDENTS

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BY

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THE UNIVERSITY OF ARIZONA

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INTRODUCTION

In this monograph on curriculum and teaching strategies for gifted students, June Maker presents a framework for curriculum design and a set of guidelines or principles for curriculum development. Curriculum for the gifted should be built upon a clear recognition of their special characteristics and needs and should open the door to the highest possible level of achievement.

Borrowing concepts from Gallagher and Renzulli, she establishes the basic framework of content, process, learning environment, and product as the major dimensions to guide curriculum development. Content, she urges, should be more abstract, complex, varied, organized in larger chunks, economical with regard to details, comprehensive, and relevant for the future.

Processes are the methods used in teaching. They include questioning strategies which induce inquiry and active exploration, open-ended activities, discovery learning, reasoning, student freedom of choice, active interaction among students, contact with mentors, fast pace, and a constant varying of methods.

The products of curriculum for the gifted are the things which they create as a result of curriculum experiences. Products should address real problems, communicate to real audiences, transform information, and be evaluated from several points of view.

Finally, the learning environment should be modified psychologically and physically. It should be (1) student-centered, (2) designed to foster student independence, (3) open to new ideas, (4) accepting, (5) complex, and (6) highly mobile. Gifted children should carry out learning more expressively in and outside the classroom.

Maker goes on to give excellent illustrations of curricula in economics, robotics, and history which illustrate all of the four basic dimensions and the related guidelines.

BRIEF BIOGRAPHY OF THE AUTHOR

Dr. C. June Maker is Associate Professor of Special Education at the University of Arizona, Tuscon. In this capacity, she is responsible for the development and coordination of graduate degrees in education of the gifted at both the master's and doctoral levels. She holds national offices in several organizations for the gifted. She has been coordinator of a graduate program at the University of New Mexico, a teacher, a regional supervisor for a state department of education, an administrative intern in the federal office for the gifted, and has consulted with numerous local school districts, state departments of education, and other public and private agencies. Her educational background consists of degrees from the University of Virginia (Ph.D.), Southern Illinois University (M.S.), and Western Kentucky University (B.S.).

CURRICULA AND TEACHING STRATEGIES FOR GIFTED STUDENTS

Intellectually gifted students can be, and are, taught in a variety of settings: regular classrooms, resource rooms or "pull-out" programs, special self-contained classrooms, special schools, and various combinations or modifications of these. Regardless of the setting, however, the principles for curricula differentiation and teaching strategies are the same. To best meet the needs of students whose capabilities in intellectual areas exceed the norm, education must be designed not only to allow, but also to encourage development at rates and in directions that may be unknown, surprising, and unplanned. In short, curricula and teaching strategies must provide a floor, but not a ceiling -- a foundation without restrictions on learning and thinking. Instruction should be designed to open, not close, students' thinking.

After stating these general ideas, the usual question is "Are these principles not important in the teaching of all students?" My usual reply is "Yes!...but how frequently are they employed for all children?" Providing an appropriate curriculum and teaching strategies for all children also requires that one recognize and build upon their characteristics and educational needs. The visible differences in students' characteristics and needs provide the clue to how one should differentiate the curriculum to accommodate variations in intellectual capacities. For example, to use the metaphor already introduced, one often finds that students who are not gifted need more emphasis on the foundation, or more contact with the foundation, than do those who are gifted. Often, students less able intellectually need a more structured or stable foundation than do those who are gifted much like the difference between stairs and a trampoline. Most students tend to learn in a step-by-step fashion, while gifted students frequently learn through a series of unpredictable intuitive leaps. Using the metaphor, they may prefer to reach higher levels by launching themselves from a trampoline of knowledge rather than climbing a series of stairs. Much more of a challenge is involved!

In short, the principles and practical suggestions presented in this monograph may be good for all students in a class, with or without modifications. However, they are absolutely essential in the education of intellectually gifted students.

A Framework and General Principles

A framework and principles are useful to all of us in whatever we do because they provide ways to generate new ideas and to justify our decisions, both to ourselves and others. The framework initially presented by Gallagher (1965) for viewing curriculum -- content, process, learning environment -- supplemented with the fourth dimension emphasized by Renzulli

(1977) -- product -- is a very useful one. By examining each of these four dimensions, general principles can be generated to describe the most effective education for intellectually gifted students -- one that provides a floor and not a ceiling, and one that meets both their present and future needs.

Each general principle defined below results from one or more traits found to be present in most intellectually gifted students. A description of these characteristics is beyond the scope of this article since its focus is on the curricula and teaching strategies. For discussions of the learning traits of gifted students and their connection to the educational process, readers are referred to Clark, 1983; and Maker, 1982.

Content

Content is the specific data, key concepts, abstract principles, and skills that students are expected to learn. The content of the curriculum for gifted students needs to meet the following general principles:

1. Abstractness. The focus of learning should be on understanding "big ideas" and underlying concepts rather than on remembering facts and ideas for their own sake. For example, students should learn about Japan's and India's cultures, their similarities and differences, and their development as examples of the cultural universals" true in all cultures across time rather than just so they will know about Japan and India.

2. Complexity. Content that is complex represents an integration of information from a variety of disciplines and a variety of sources. The content of a teaching unit on the topic of culture, for instance, is made more complex if examinations of the art, language, music, history, geography, and current events are integrated. Complexity is also increased if a variety of cultures -- ancient and modern, eastern and western, industrialized and agriculture -- are studied.

3. Variety. The curriculum for intellectually gifted students should contain content not usually included, and should be chosen for "(a) its relevance to the principles and concepts serving as the focus of instruction, (b) the interests of the students, (c) its ability to contribute depth and breadth of understanding, and (d) its relevance for the future." (Maker, 1986, p. 64)

4. Organization. Learning and memory are facilitated if the facts, ideas, concepts, and skills to be taught are organized around key concepts and "big ideas" rather than haphazardly or chronologically. For example, key concepts regarding cultures are learned more effectively if the different examples are studied at a similar period of time. Teaching about Japan in second grade, India in third grade, and the Aztecs in fourth grade does not develop the broad concepts students need to learn about culture universals and how cultures develop as does the study of these various cultures as part of one unit of study focusing on cultures and how they develop.

5. Economy. Irrelevant and unnecessary learning needs to be minimized, as does forgetting and relearning. When one thinks of the number of facts (about history, geography, art science) which most students memorize just to pass a test, and then promptly forget, one should become even more determined to emphasize this learning principle. If a fact is important enough to learn, it is important enough to learn in a way that it can be applied, used, and remembered long after a test is given. If this unnecessary learning were to be eliminated, many of our gifted students might be able to go to school for 12 years rather than 20 to get a Ph.D.!

6. Comprehensiveness. Academic/scholarly areas of study contain four major types of content: 1) conclusions and ideas resulting from thought and empirical studies, 2) significant people, 3) methods for study and problem solving, and 4) attitudes and values that have shaped the field in the past and will continue to influence it in the future. Gifted students need exposure to all these types of content in each area of study.

7. Revelance for the future. Content that is relevant for the future includes the key concepts and "big ideas" important in academic areas, as well as the skills of problem solving, computer literacy, divergent thinking, analytical thinking, self-direction, goal-setting, and making predictions. Many other skills can be subsumed under the topics of "learning to learn" and "coping with change."

Process

Processes are the methods used in teaching. They should be designed or selected to fit the content being taught, and should also meet the guidelines presented in the following principles:

1. Employ systematic questioning strategies. The most important factor influencing development of thinking and reasoning in students is the type of questioning employed by the teacher. Models for questioning that are focused, purposeful, and sequential, will assure that thinking skills other than memory and recognition are emphasized if the teacher uses them frequently and appropriately and in an integrated fashion rather than separating them from the development of content understandings.

2. Ask open-ended questions and design open-ended activities. Questions and activities that follow this guideline (a) cannot be answered by "yes" or "no," (b) have more than one right answer, (c) have no specific answer the teacher wants to hear, and (d) are provocative in that they stimulate divergent thinking and further thought on a topic. Different answers and responses are encouraged (and expected) from many students.

3. Use discovery learning in a variety of situations. Free exploration, as well as guided use of inductive reasoning to realize relationships, formulate general principles, and construct original explanations of observed phenomena are both important aspects of discovery learning.

4. Focus on reasoning. Often, the only part of a student's answer or response considered important is the inference or conclusion made--the result of the student's thinking. A focus on reasoning, however, requires that teachers focus both on the result and on the process of the student's reasoning. Students are asked to explain how they arrived at an answer--their reasoning, their evidence, their logic. Both the teacher and other students profit from such explanations.

5. Allow freedom of choice. Certainly teachers must provide structure, direction, and exposure to a variety of topics and ideas, based on their experience and understanding of what students can do or may need in the future. However, within a general structure, students need to be allowed and encouraged to make choices based on their own interests and perceived needs. As students get older, they should be permitted more freedom of choice in both what to learn and how to learn.

6. Encourage interaction in real and simulated situations. Discussions, simulation games, communication activities, group dynamics techniques, and activities to develop leadership skills are important methods to use with gifted students. Videotaping offers an "outsider's " perspective and allows students to see clearly their behavior and its results.

7. Provide contact with role models and mentors. Adults with similar abilities who have used their abilities successfully, and who are pleased with their lives are important influences on gifted students. Working with these students, as well as discussing their lives is valuable to students.

8. Pace learning appropriately. New materials can usually be presented more rapidly to intellectually gifted students because of their fast learning rates. However, the pace of discussions and activities requiring problem solving, in-depth thought, and divergent thinking may need to be slower than with other students because of greater involvement in the activities on the part of gifted students.

9. Use varied methods. Group discussions, lectures, independent studies, learning centers, simulation games, group projects, cooperative learning, and many other methods should be combined to (a) accommodate different learning styles, (b) provide a stimulating atmosphere, and (c) avoid repetition.

Product

Products are the tangible and intangible results of learning, and the products expected of gifted students should resemble, to the extent possible, the products developed by professionals in the various fields of study. Guidelines for development of products follow:

1. Address real problems. Problems investigated should be real and of interest to the students--not contrived by the teacher only to meet a particular instructional goal.

2. Address real audiences. Products developed by professionals have a definite purpose and a particular audience. The type of audience usually influences greatly the form of the product. For example, a report of research on food thrown away in the school cafeteria should be directed toward a school administrator or cafeteria supervisor rather than the student's teacher.

3. Transform existing information. Copying, paraphrasing, or summarizing existing information or the work of other students is not an appropriate task for gifted students. They should collect and analyze raw data, draw their own conclusions, write original stories or poems, and produce original artwork.

4. Evaluate using various people. Gifted students, their peers, the real audience, and simulated audiences should all be participants in the evaluation process. Self-assessment should be a major factor in the evaluation of products.

Learning Environment

Both the physical and the psychological environment must facilitate the implementation of content, process, and product curricular principles outlined in the sections above. The learning environment for gifted students must meet the requirements listed below:

1. It should be student-centered rather than teacher-centered, focusing on ideas and interests of students more than those of the teacher.

2. Teachers should use methods that foster student independence from rather than dependence upon the teacher through encouraging students to solve their own problems, keep their own records, and manage their own classroom--rather than imposing solutions and managing all elements.

3. Both the physical and the psychological environment should be open (to new people, new ideas, exploration, and new directions) rather than closed.

4. Student ideas and personalities must be accepted and understood rather than rejected or judged by both the teacher and the other students, especially when students are developing new ideas and taking risks they have not taken before.

5. Complexity (of materials, references, books, tasks, methods, and ideas) rather than simplicity must be emphasized.

6. Teachers and administrators must allow and encourage high mobility rather than low mobility both within and outside the classroom.

Sample Activities and their Relationship to the Framework and to General Principles

In this section, a series of teaching activities that can be implemented in a variety of settings will be described. These activities often illustrate most, if not all of the general principles presented. After the activities are described, a chart will indicate how the general principles were addressed in designing the activities. A short discussion and summary will follow to explain the relationships between activities and principles.

To achieve instructional objectives and economy in the teaching process, the four dimensions of the curriculum--content, process, product, and learning environment--should not be separated. In fact, to achieve maximum benefit, most leaning activities planned for gifted students should be designed to achieve (a) an understanding of key concepts or idea, (b) development of thinking skills, and (c) enhancement of ability to produce professional products. The effectiveness and learning value of activities are also increased when they meet three additional conditions: (a) build upon and extend the regular curriculum, using it as a foundation, rather than being totally separate, (b) involve several ages and grade levels of gifted students, and (c) be part of an overall curriculum scope and sequence designed to meet the learning needs of gifted students.

Economics

To teach a unit on economics, one teacher planned field trips to several businesses in the city. The class visited an investment company, a restaurant and bar, and a wholesale/retail fish market. The employees of these businesses were asked to explain as clearly and thoroughly as possible how their companies functioned, how their individual jobs fit into the whole picture, and what skills were needed. Students were invited to return if they wished.

After each field trip, and after all were completed, the teacher held discussions in which the students were asked to identify key features of each business and to note the similarities and differences among the three visited. Since they were studying economics, the students decided they would try to make money through establishing their own businesses. One group decided to establish an investment company and another decided to develop and operate a bakery during recess and lunch time at their school. Students became very involved, using what they had learned about advertising, buying, and selling to establish very effective businesses. The projects were so exciting that the entire school became involved. Employees from the investment company and restaurant were asked to become consultants to the class and were very helpful when students encountered problems.

Many learned about the stock market through their investments, while those who operated the investment company learned valuable mathematical skills and concepts. Students who managed the restaurant learned similar concepts and skills in addition to nutritional concepts and cooking skills. When the businesses closed, both teacher and students were pleased with

the results. A final evaluative discussion was held, in which students reviewed what concepts they had learned, discussed who they could improve their businesses, and assessed their success as business men and women. Employees from the three businesses initially visited were invited to participate in the evaluative discussion to contribute their assessment of the success of the project and suggestions for improvement. Students had learned a lot, had fun, and even made substantial profits.

Historical Research

Several teachers are cooperating in this interesting project. At the elementary level, students visit an old cemetery in the city. Each student records all possible information about five people from the gravestones: name, sex, date of birth, date of death, nationality, number of children, age, and whether married or not. Next, they go to the county records office, where workers explain the systems for keeping historical records about the people living in the country. Students then examine these records and attempt to gather even more information about their five individuals. Newspapers and other similar sources are also available to supplement the legal data. When all students have completed their research, important data about all individuals are recorded on charts. Students then examine these charts for trends, similarities, and differences such as the following: increasingly longer length of life, years with greater than usual percentages of births or deaths, people of certain nationalities more common than others during particular years, and sizes of families at certain times. After significant trends are noted, students are asked to make inferences about what might have caused these trends. Inferences are based on their reading of newspaper articles, county records, interviews with parents and grandparents, and students' own creativity.

Students at the junior high and high school levels are involved in a related project. They have become interested in the historical areas of the city, and are researching particular buildings that have historical significance. Each student or group of students has selected a building currently being considered for restoration through grants from the National Historical Society. Using criteria developed by the society for allocating grants, they are developing proposals to be submitted to the City Council. Since one criterion is that the building have distinctive history and a particular significance such as association with important people or events, and one is that the building have a distinctive architectural style, students must locate primary source data about their buildings and relate this specific information to what they are learning (or have previously learned) in their Arizona History classes. Since several citizens' groups are currently working on these proposals, the students are assisting, and will accompany the groups when proposals are reviewed by the City Council.

As a culminating activity, the elementary, junior high, and high school students present their information to each other, and a discussion is held for the purpose of integrating ideas. In a related activity one of the students in a computer skills class developed a software package capable of analyzing information from the cemetery research and building restoration project.

One group of students developed a guide to the unrestored historical buildings of the city, another wrote a very interesting article about the "unimportant people who were signigicant in the city's history."

Robotics

In this unit, students combined their studies of computers, physics, electricity, and futures. They examined the many uses of robots in the past and present, and participated in discussions in which they made inferences and predictions about the uses of robots and the expanded field of robotics in the future.

To simulate the actual process of development, design, and building of new technology, each student group was required to design its robot first, and submit this design to a panel of reviewers for comments and suggestions. The designs included drawings, list of materials needed for construction, sources of the materials, approximate cost, skills ended by builders, and the approximate time needed for construction. The teacher, a robotic expert from the community, and older students who had previously participated in the unit reviewed the plans and made suggestions for improvements.

Small groups of students worked together to create robots of the future based on current technology. Materials used to build the robots needed to be donated by businesses or "found" by the students--they were not allowed to purchase materials.

As the groups were working, the teacher assisted by arranging seminars on topics that related to the work of the various groups. Whenever students were having problems in their construction, experts from the community and older students were asked to assist the students.

One student group that was not interested in building a robot designed a display on robotics that included the class's robots, their designs, and a variety of information about robotics. They contacted various agencies and organizations, and arranged for the display to be shown. Included in the display was a request for comments, which included the responder's evaluation of the display and suggestions for improvement. Sponsors of the display were also asked to provide their evaluation based on informal comments heard from those who viewed it.

As a result of this activity, several students became interested in pursuing careers in related areas. The teacher then arranged for field trips, visitations, and eventually, internships for students in computer technology, electrical research/technology, electrical and computer engineering, and robotics research related to social issues.

Relationship of Activities/Units to Curriculum Principles

In the tables that follow, the general principles for designing content, process, products, and learning environments appropriate for gifted students are further illustrated by showing how they have been incorporated into the activities and units of study described. At the top of each table are listed the activities, and along the side are listed the general principles in each of the three areas.

As is clear from examining these tables, all the curriculum principles were incorporated into the units of study, although the specific aspects of each unit differed. The historical research unit was more teacher-directed than were the other units due to the topic and the students' lack of experience in conducting historical research. However, student initiative and choice were encouraged within the structure provided. In all three cases, the teacher determined the general areas of study and planned initial activities that would spark the interests of the students. Students were also encouraged to be active learners through small-group and individual projects. Students could develop concepts the teacher wanted them to learn (while at the same time developing concepts and skills the students wanted to learn).

Various traditional disciplines were included in the units of study, and important concepts relevant across those disciplines were the focus of study. Historical information was made relevant because its usefulness for interpretation of present events and prediction of the future was demonstrated clearly. Economy of learning was also achieved by building upon the students' experiences from the regular curriculum, teaching what students needed based on difficulties they were having (rather than trying to teach all the skills they needed before allowing them to apply these skills), and integrating objectives for content, thinking processes, and products into single units of study.

The community was involved and students were given many opportunities to work with adults who later became mentors to them. In addition, community involvement began with demonstrations and information dissemination, continued with development of skills and refinement of understanding of information through consultation and involvement with student projects, then ended with assessment of learning through participation in product evaluation and discussions about how projects could have been improved.

Several grade levels of students were involved in all units, and the historical research project even extended across elementary, junior high, and high school, thus achieving additional benefits. Teachers cooperated in these projects, thereby achieving articulation across grade levels.

Finally, descriptions of these activities were not complete enough to demonstrate how they were part of an overall plan in the learning of gifted students. To demonstrate this aspect of the curriculum design, readers would need to consult the curriculum scope and sequence

developed in each school where the activities were carried out. For further discussions of scope and sequence development and implementation related to the general principles discussed in this article, the reader is referred to an earlier article by the author. (Maker, 1986)

Summary and Conclusion

As stated at the beginning of this article, intellectually gifted students can be taught in a variety of settings. Each unit described in the article, and each general principle, can be implemented in all these settings. Certainly, having gifted students clustered together in either a regular classroom, a pull-out program, or special classes and schools, would facilitate implementation of many of these principles. However, having gifted students work with these principles in regular classrooms would be valuable for all the students as well. Many of the activities allow for choice of groups or roles within groups, which would be a valuable way to differentiate between ability levels of students. Choices are made by students, with assistance from the teacher, so all students would be able to accept challenging roles whether gifted or not. In short, all the activities described in this article provide a foundation for learning, but do not establish a ceiling.

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1. Abstractness

Purpose was to develop concepts of economics, not specific operation of business or computation skills.

Although students learned specific facts related to people and buildings, they were not required to remember them, but they used them to infer causes.

Purpose was to develop abstract concepts related to construction and use of advanced technology.

2. Complexity

Concepts developed included those from math, economics, social studies.

The discipline of history was combined with sociology and current events in this unit.

Computer technology, physics (machines), electricity, and futures studies were integrated.

3. Variety

Concepts and skills learned are usually taught at later grades or not at all.

History of the local area and state were taught in unusual ways and related to interests of the children.

Many concepts, not usually a part of the curriculum, were integrated.

4. Organization

Many businesses were studied to develop the key concepts. Historical concepts were taught in a concentrated period of time.

Related ideas were taught in a similar period of time.

Information from many fields was integrated.

5. Economy

Learning by doing, as well as organization and integration of concepts and skills facilitated economy.

Combining the grade levels facilitated economy, as did building upon concepts taught in the regular curriculum.

Basic concepts were taught, then students produced designs and afterward the teacher arranged assistance when needed.

6. Comprehensiveness

Learning included conclusions and methods in field of economics, attitudes, and values. Only recent people were studied.

Unit included a focus on historical research methods, significant people, attitudes, and values related to history, as well as events and facts.

Concepts in three fields were learned, as were the methods of construction. Initial plans were reviewed by a design team.

7. Relevance for the future

Both economic concepts learned and personal investment skills will be valuable in the future.

An understanding of historical research, use of primary sources for study, and knowledge of county recording process will be helpful to many in the future.

Knowledge of robotics will be useful in the future, as will skills developed in construction and display.

1. Employ systematic questioning strategies.

Bloom's Taxonomy was used in designing the whole unit. Taba's concept development guided some discussions.

Taba's interpretation of data strategy was the major model for identifying trends and making inferences.

Parnes's creative problem-solving model was used by groups in designing robots.

2. Ask open-ended questions and design open-ended activities.

Students designed businesses of their own. Discussion questions had many answers.

Questions included (a) What trends have you noticed? (b) What are some possible causes of these trends?

Robot design could be as complex as desired. Questions in creative problem solving are all open-ended.

3. Use discovery learning in a variety of situations.

Students discovered many economic concepts through their attempts to make profits.

Students discovered relationships between historical events, people's lives, and buildings.

Students discovered how many fields are integrated in one area.

4. Focus on reasoning.

In discussions, students were always asked to justify their answers about possible causes, future directions, problems, and trends by explaining their logic, reasons, and information bases.

5. Allow freedom of choice.

Students chose to develop businesses, and select their roles within them.

Students chose the people to study, as well as the buildings for research.

Students chose to build robots, serve on review team, or develop the display.

6. Encourage interaction in real and simulated situations.

Structured interaction occurred in discussions, while operation of the businesses required both structured and unstructured.

Discussions fostered interaction with the teacher as guide, and work on presentations was accomplished by small groups interacting.

Small groups developed robots together, and discussions of future uses of robots were held.

7. Provide contact with role models and mentors.

Visitations to businesses provided contact with possible mentors.

Historians and citizens interested in preservation worked closely with students.

Students worked closely with experts, then the teacher arranged internships.

8. Pace learning appropriately.

Much information was gained in only three visits to businesses, but application and discussion consumed much time.

Rather than being presented with new information, students gathered it at their own pace, then discussed it very thoughtfully.

Short presentations of information were made to large group, then while groups worked, needed information was given.

9. Use varied methods.

Methods included field trips, discussions, a simulation, reading, small group cooperation, and individual research were used.

Methods employed were discussion in large and small groups, lectures, field trips, individual research, cooperative learning, drawings, constructions.

1. Address real problems.

Students chose to develop and operate businesses to see if they could make a profit.

Through contact with real citizens of the community, both past and present, history became real to the students.

Students decided to build robots, and some chose to disseminate information about them to the public.

2. Address real audiences.

Other students in the school were the real audiences.

Proposals to the city addressed real audiences, the guide to "unimportant people" and to unrestored buildings were directed toward real audiences.

Review panels for designs were simulated audiences, but included adults. The public also viewed the display.

3. Transform existing information.

Information was transformed into successful businesses.

Data about people and buildings were changed into inferences about causes and effects of trends. Books and proposals also reflected this transformation.

Information was transformed into fully-operating robots and creative displays about robotics.

4. Evaluate using various people.

Final discussion included self-assessment, as well as evaluation by the teacher and business people visited. Assessment by other students participating would also be helpful.

Student ideas about causes of trends were often confirmed or rejected by historical facts. Other students, the citizens groups, the city council, and the general public were involved in evaluation.

Assessment of plans for robots was made by a team of individuals. Final assessment was made by the designers, and the public made comments about the display.

1. Student-centered vs. teacher-centered

The teacher chose economics, but student interest determined further activities.

The teacher determined the general topic, but allowed choices, and centered discussions on student ideas.

The teacher determined general topic, but students chose to build robots and decided how to do so.

2. Independence vs. dependence

Students were responsible for requesting information and materials, and for all planning activities.

Students assumed responsibility for gathering information, interviewing other people, and arranging meetings with citizens groups.

Students were responsible for telling the teacher when they needed outside assistance and for securing materials.

3. Open vs. closed

Ideas of adults outside the classroom were welcomed and valued through field trips, consulting, and evaluation.

Older students and the teacher were considered history experts, and student initiative in developing new explanations for history was encouraged.

Speakers were invited at various times, as were experts, to consult on construction. A different activity was encouraged for those not desiring to make robots.

4. Accepting vs. judging

The teacher encouraged students to use their own ideas for advertising and for operation of the businesses.

No student inferences about causes were rejected by the teacher. Students were encouraged to develop thoughts and then check the facts. Students developed proposals for construction, and these were reviewed carefully before any changes were suggested.

5. Complexity vs. simplicity

Developing businesses is complex, and often an adult only task.

Tasks were complex--those of historians and citizens groups; many types of working environment were needed.

Classroom needed a variety of working areas for the many activities, and the tasks were very complex.

6. High mobility vs. low mobility

Students left the classroom for field trips and operation of the restaurant and moved freely throughout the classroom when working.

Primary source materials were used outside the classroom, small groups worked together and moved freely within the classroom. Working students needed to move freely, make field trips when necessary, and hold large group discussions with experts.

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